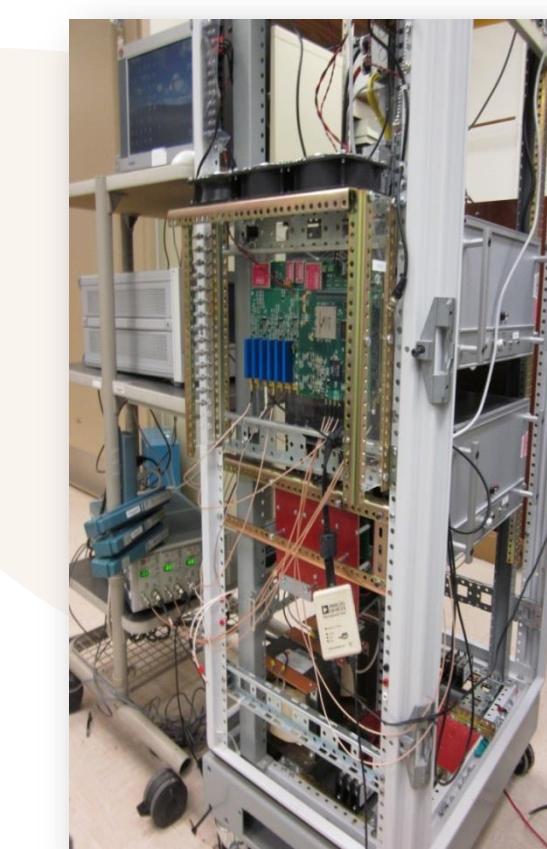
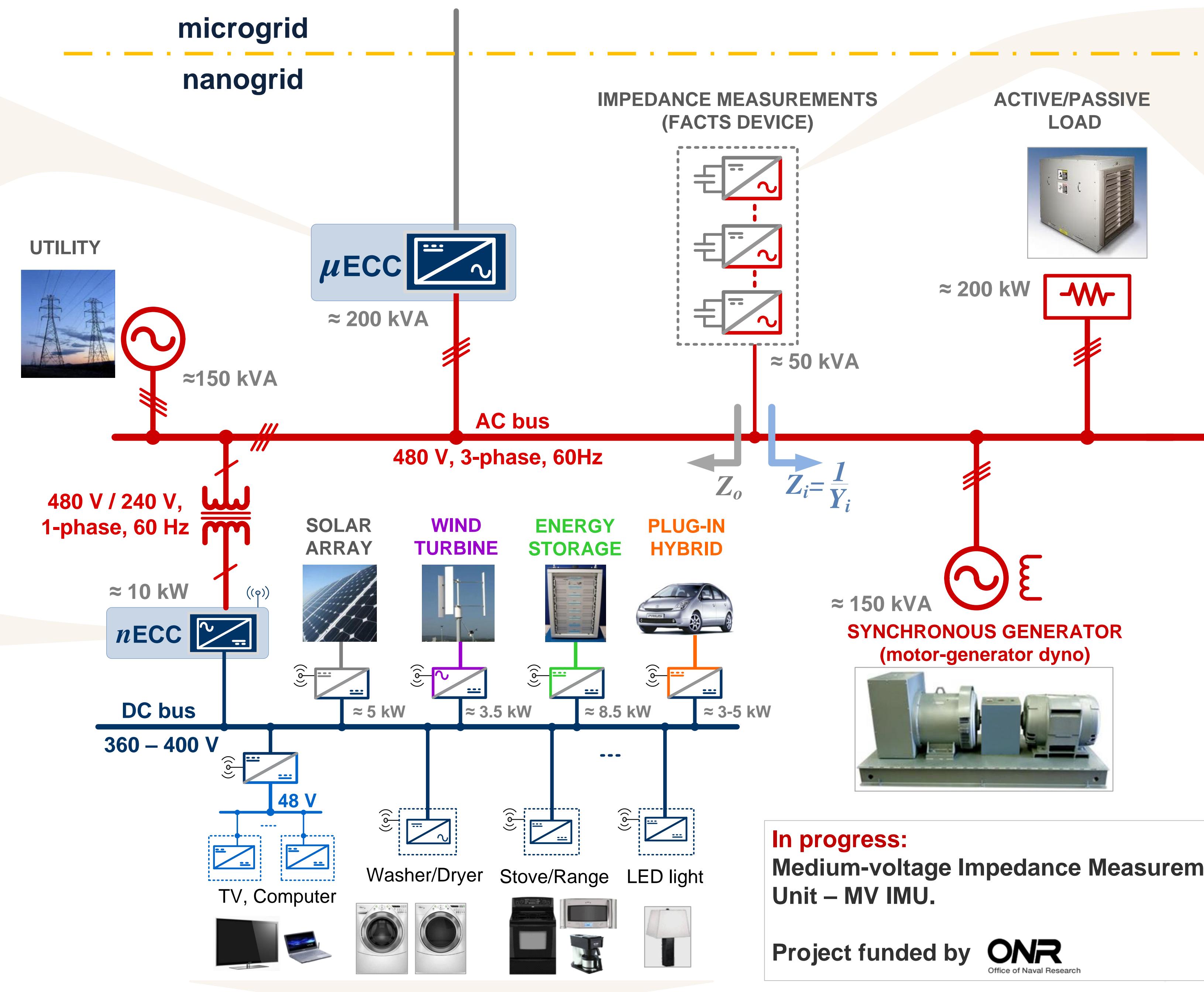




3-level Active Neutral Point Clamped Grid-Interface Converter
micro Energy Control Center μ ECC

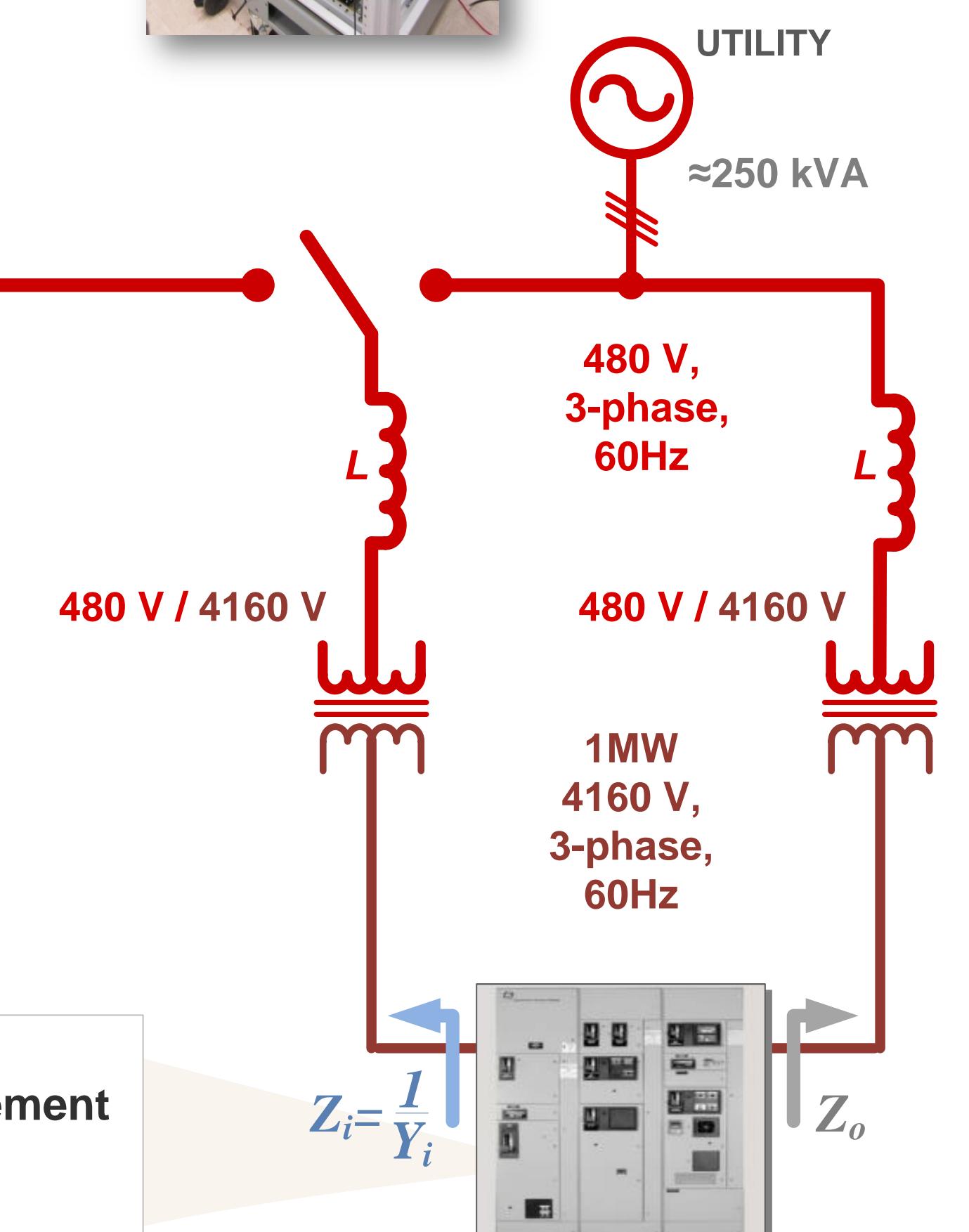


Grid-interface Converter
nano Energy Control Center - nECC



In progress:
 Multi-level Converter (Cascaded H-bridge) for impedance measurements. Will be also used for FACTS devices related research.

In the picture: Current 70 kW ac-Impedance Analyzer.



In progress:
 Medium-voltage Impedance Measurement Unit – MV IMU.

Project funded by **ONR**
 Office of Naval Research

MEDIUM VOLTAGE IMPEDANCE MEASUREMENTS / RECIRCULATING POWER SYSTEM

Small-signal Stability at DC Interface:

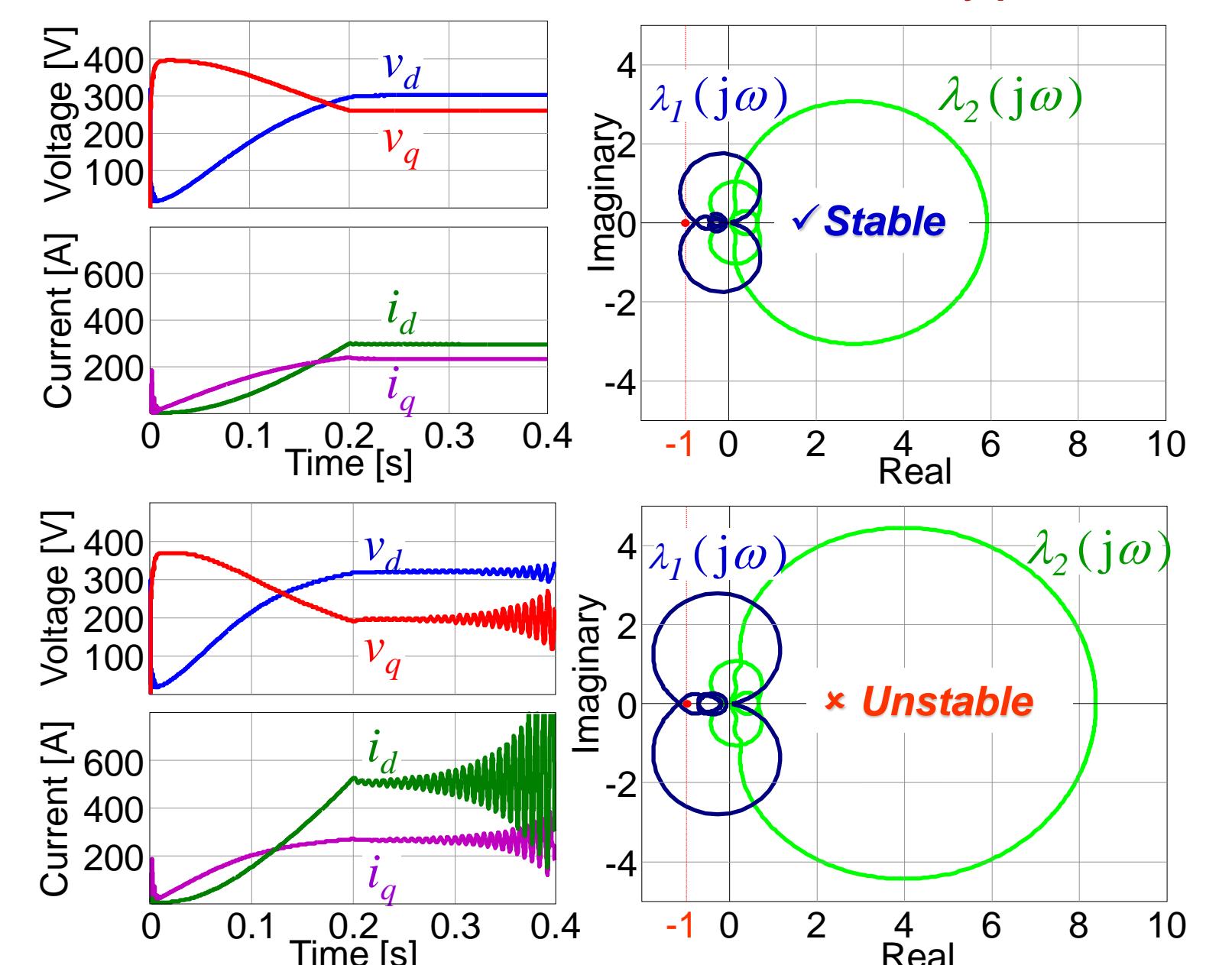
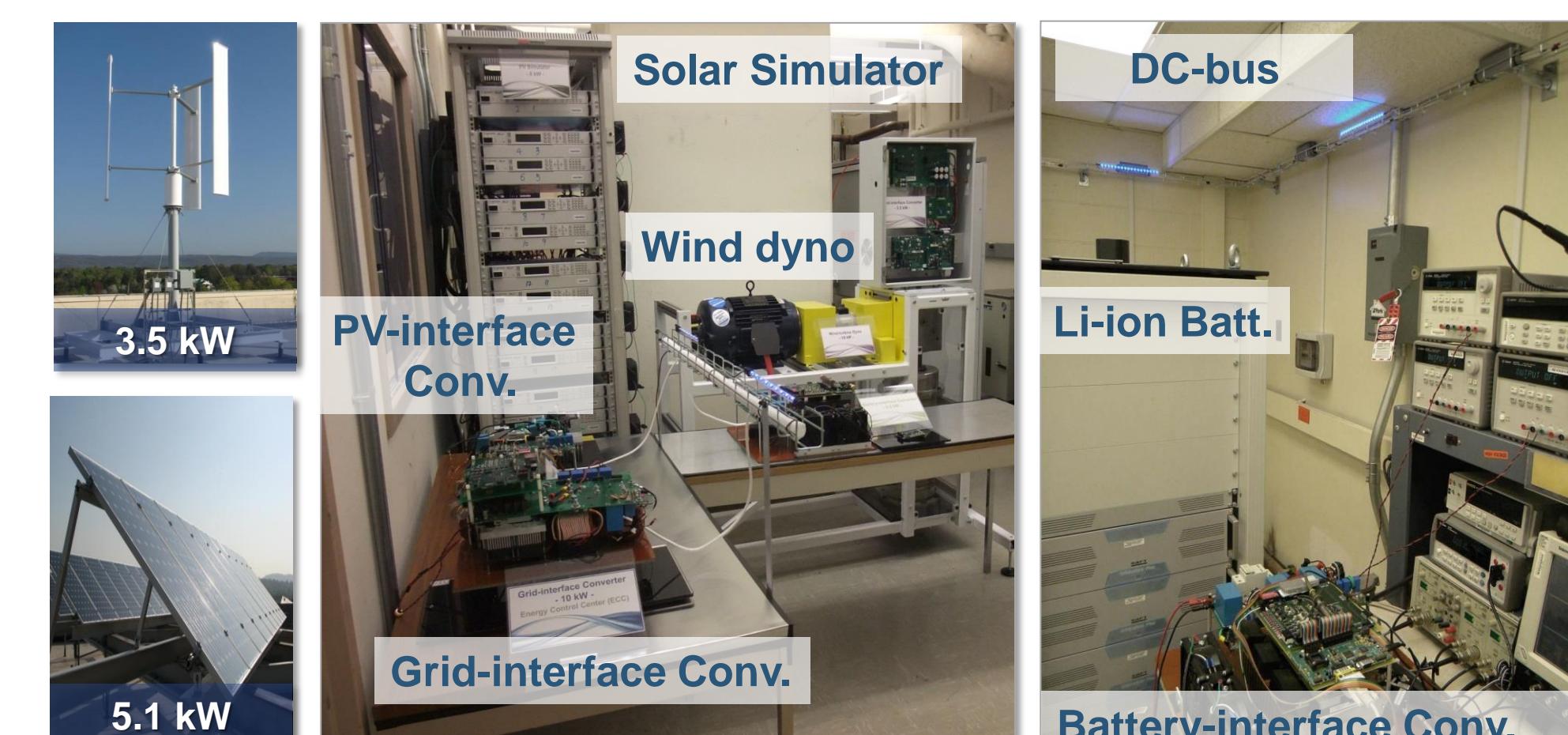
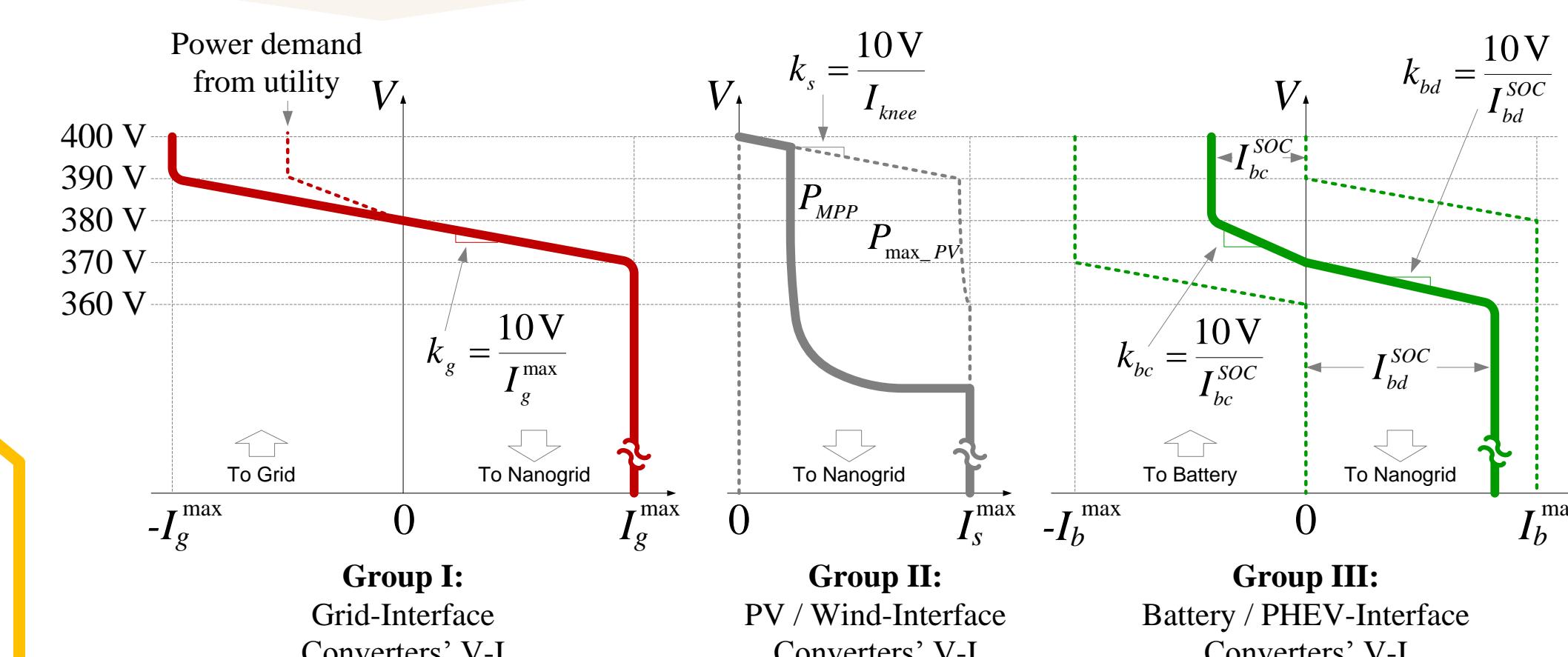
$$V_{dc} = \frac{V_{dc0}}{1 + Z_o/Z_i}$$

Nyquist Criterion

Small-signal Stability at AC Interface:

$$V_{ac} = [1 + Z_o \cdot Z_i^{-1}]^{-1} \cdot V_{ac0}$$

Generalized Nyquist Criterion



REN Research Scope:

DC Nanogrid Operation and Performance

- Nanogrid architectures and design
- AC-DC nanogrid-interface converter
- Battery-, PV- and wind- interface converters
- Power management strategies
- System stability, operation and performance
- Hierarchical system modeling, analysis, and design

Modular Multi-level Converters

- Modeling, design and control of modular multi-level converters
- Modular multi-level converter for impedance measurements in ac- and dc- grids
- Multi-level AC-DC grid-interface converters (Energy Control Center)
- Harmonic/EMI filter design for multi-level AC-DC grid-interface converters

Power Electronics for Improved Grid Performance and Renewable Sources and Storage Systems Integration

- Dynamically-decoupled electronically-interconnected sub-networks (picogrid, nanogrid, microgrid, ...intergrid)
- Power sharing, dynamic interactions, and stability
- Power electronics converters for P-f and Q-V operation with enhanced synchronization capabilities
- FACTS devices with enhanced control, synchronization, and power conversion capabilities